

Appl. No. 09/943,843
Amdt, dated January 21, 2004
Preliminary Amendment

PATENT

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1. (Currently Amended) A semiconductor device, comprising:
a semiconductor substrate;
a gate insulation film formed on one major surface of said semiconductor substrate and including titanium oxide; and
a gate electrode film formed in contact with said gate insulation film, said gate electrode film having a dual function of being an electrode and a diffusion barrier, said gate electrode film being configured to minimize diffusion of conductive elements into said gate insulation film to reduce a current leakage via the gate insulation film, said gate electrode film including ruthenium oxide or iridium oxide,
wherein said titanium oxide is in the form of a crystal of rutile structure,
wherein said gate electrode film and titanium oxide cooperate to reduce the diffusion of conductive elements of said gate electrode into said gate insulation film, so that the diffusion of the conductive elements of said gate electrode is less than that of when said gate electrode comprises Si, W, WSi₂, Mo, MoSi₂, Ti, or TiN.
2. (Currently Amended) A semiconductor device, comprising:
a semiconductor substrate;
a gate insulation film formed on one major surface of said semiconductor substrate and including titanium oxide; and
a gate electrode film formed in contact with said gate insulation film, said gate electrode film having a dual function of being an electrode and a diffusion barrier, said gate electrode film being configured to minimize diffusion of conductive elements into said gate insulation film to reduce a current leakage via the gate insulation film, said gate electrode film including ruthenium oxide or iridium oxide.
~~A semiconductor device according to claim 1,~~

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wherein film thickness of said gate insulation film is greater than about 0.9 nm and less than about 3 nm,

wherein said ruthenium oxide or iridium oxide being at least 50 percent in composition of said gate electrode film.

3. (Canceled)

4. (Currently Amended) A semiconductor device, comprising:
a semiconductor substrate;
a gate oxide film formed on one major surface of said semiconductor substrate, said gate oxide film being titanium oxide and having a given crystal structure; and
a gate electrode formed over said gate insulation film, said gate electrode including a conductive oxide layer and a metal layer, said conductive oxide layer being provided between said gate oxide film and said metal layer,
wherein said gate oxide film is greater than about 0.9 nm and less than about 2 nm in thickness.

5. (Currently Amended) A semiconductor device according to claim 4,
wherein said conductive oxide layer includes ruthenium oxide or iridium oxide,
~~wherein film thickness of said gate oxide film is greater than about 0.9 nm and less than about 2 nm,~~
wherein thickness of said gate electrode is at least 0.9 nm.

6. (Previously Presented) A semiconductor device according to claim 4,
wherein said titanium oxide has a rutile crystal structure.

7. (Previously Presented) A semiconductor device according to claim 5,
wherein said metal layer includes ruthenium or iridium.

8. (Currently Amended) A semiconductor device, comprising:
a semiconductor substrate;

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a titanium oxide gate insulation film formed on one major surface of said semiconductor substrate and being no more than about 2 nm in thickness;

a gate electrode including conductive oxide film and a metal film, said conductive oxide film being in contact with said gate oxide and configured to serve as a diffusion barrier to prevent diffusion of an element into said titanium oxide to reduce a current leakage via said titanium oxide film;

a first capacitor electrode formed on said one major surface of said semiconductor substrate;

a capacitor insulation film formed in contact with said first capacitor electrode and exhibiting a high dielectric constant or ferroelectricity; and

a second capacitor electrode formed in contact with said capacitor insulation film, wherein said titanium oxide is provided with a given crystal structure, so that said titanium oxide cooperates with said gate electrode to reduce the diffusion of conductive elements of said gate electrode into said titanium oxide.

9. (Previously Presented) A semiconductor device according to claim 8, wherein thickness of said insulation film is at least about 0.9 nm and thickness of said conductive oxide film is at least about 0.9 nm.

10. (Previously Presented) A semiconductor device according to claim 8, wherein said titanium oxide has a rutile structure or anatase structure.

11. (Previously Presented) A semiconductor device according to claim 8, wherein said metal film includes ruthenium or iridium, said ruthenium or iridium comprising at least 50 percent of said metal film in composition.

12. (Currently Amended) A semiconductor device, comprising:
a semiconductor substrate;

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a gate insulation structure including of a first gate insulation film formed over said semiconductor substrate and including silicon oxide or titanium silicate and a second gate insulation film formed over said first gate insulation film and including titanium oxide; and
a gate electrode film formed in contact with said gate insulation structure and including ruthenium oxide or iridium oxide,

wherein film thickness of said second gate insulation film is greater than about 0.9 nm and less than about 2 nm.

13. (Currently Amended) A semiconductor device, comprising:

a semiconductor substrate;

a gate insulation structure including a first gate insulation film and a second gate insulation film formed on said first gate insulation film and containing titanium oxide of a given crystal structure; and

a gate electrode including a first gate electrode film formed in contact with said second gate insulation film and containing ruthenium oxide or iridium oxide and a second gate electrode film containing one selected from a group consisting of ruthenium, iridium, platinum, tungsten and molybdenum,

wherein said given crystal structure of said titanium oxide and said first gate electrode film configured to inhibit diffusion of an element into said gate insulation structure,

wherein film thickness of said gate insulation film is greater than about 0.9 nm and less than about 3 nm.

14. (Withdrawn) A method of manufacturing a semiconductor device, comprising the steps of:

forming a gate insulation film containing titanium oxide as a primary constituent material on one major surface of a semiconductor substrate; and

depositing on said gate insulation film a conductor film containing ruthenium or alternatively iridium as a primary constituent material to thereby form a gate electrode film.

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15. (Withdrawn) A method of manufacturing a semiconductor device, comprising the steps of:

- forming a gate insulation film containing titanium oxide as a primary constituent material on one major surface of a semiconductor substrate;
- depositing on said gate insulation film a conductor film containing ruthenium or alternatively iridium as a primary constituent material to thereby form a gate electrode film;
- forming a first capacitor electrode;
- forming a capacitor insulation film having high dielectric constant or ferroelectricity in contact with said silicon first capacitor electrode; and
- forming a second capacitor electrode in contact with said capacitor insulation film.